

## TYPHOON TOM (25W)

### I. HIGHLIGHTS

Tom was the third of five significant TCs to form in the monsoon trough. At one point, Tom, Violet (26W), Willie (27W) and a subtropical (ST) low existed simultaneously along the trough axis (Figure 3-25-1a, b). Due to the relative motions of these TCs (and the ST low), the trough axis became reverse oriented. Both Tom and Violet (26W) were large TCs. Tom also had an unusual structure featuring a "pin-hole" eye in a small central cloud mass surrounded by extensive peripheral rain bands within a large outer wind field. Tom is a good case for the argument that the core of a TC is largely independent of its outer structure.

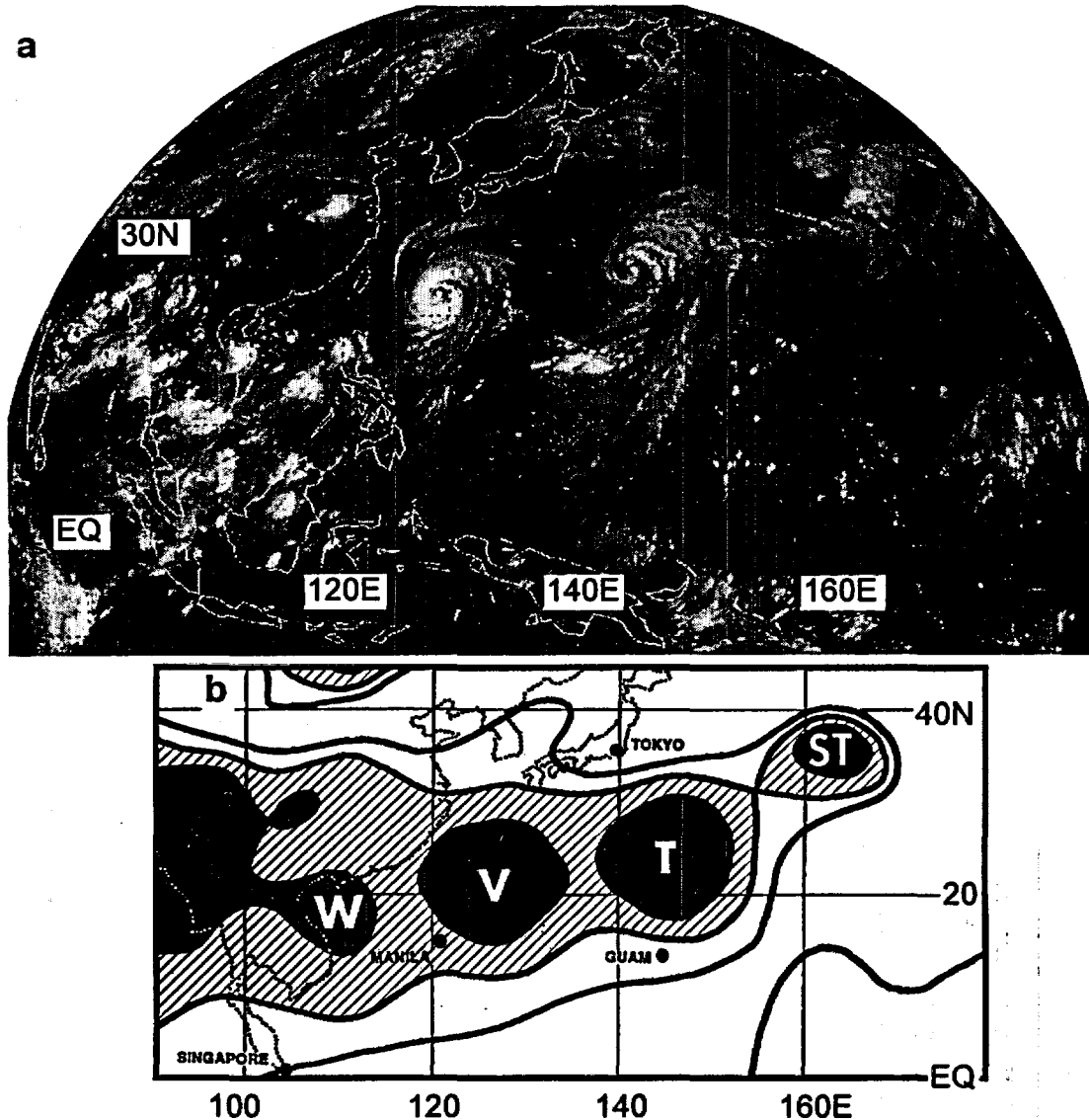


Figure 3-25-1 From west-to-east, TCs Willie (27W), Violet (26W), Tom (25W), and a subtropical low lie along the axis of a reverse-oriented monsoon trough. (a) 171231Z September infrared GMS imagery. (b) Sea-level pressure analysis (outer contour is 1010 mb, cross-hatched areas are between 1004 and 1008 mb, and black regions are less than 1004 mb) (Illustration based upon NOGAPS 170000Z September SLP analysis).

## II. TRACK AND INTENSITY

During the second week of September, the cloudiness associated with the monsoon trough began to consolidate into discrete areas of persistent convection. A low-level cyclonic circulation located to the southwest of the easternmost of these areas became Tom, and was first mentioned on the 080600Z September Significant Tropical Weather Advisory. Embedded in an ensemble of poorly organized MCSs, the weak surface low drifted westward for two days with little development. Then, early on 11 September, the convection associated with the surface circulation became better organized, prompting the JTWC to issue a Tropical Cyclone Formation Alert valid at 102030Z. Moving toward the northwest, the deep convection associated with the system began to consolidate. Based on satellite intensity estimates of 25 kt (13 m/sec) and synoptic conditions deemed favorable for further development (e.g., good outflow in all quadrants as revealed by water-vapor derived

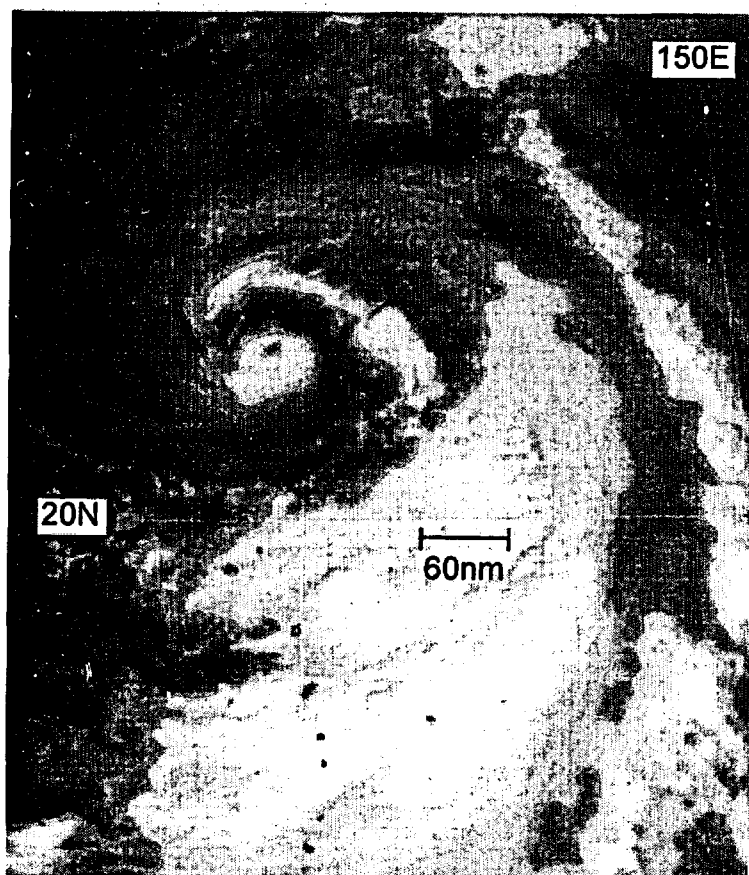


Figure 3-25-2 Tom reaches its peak intensity of 75 kt (39 m/sec). Note the small size of the eye and core cloud features with respect to the peripheral cloud features (160131Z September visible GMS imagery).

winds), the first warning on Tropical Depression (TD) 25W was issued valid at 111800Z. Moving slowly toward the northwest, TD 25W became Tropical Storm Tom on the warning valid at 121200Z. Tom became a typhoon at 150000Z. Also at 150000Z, Tom began to move slowly toward the northeast, almost at the same time as Typhoon Violet (26W) (located approximately 1100 nm (2050 km) to Tom's west-southwest) did likewise. The turn to the northeast of Tom and Violet (26W) was associated with the monsoon trough acquiring a reverse orientation (as mentioned in the 150000Z Prognostic Reasoning for Typhoon Tom).

A common behavior of typhoons moving northeastward in a reverse-oriented monsoon trough, Tom continued to intensify while moving northeastward at 6 kt (11 km/hr), reached its peak of 75 kt (39 m/sec) at 151800Z (Figure 3-25-2), and maintained that intensity until after 161800Z. Slowly gaining forward speed, Tom gradually weakened as it moved toward the northeast. It eventually became a large extratropical low, but not before undergoing a lengthy period of

extratropical transition for which the JTWC satellite forecasters instituted a new intensity estimation technique developed by Miller and Lander (1996) (see the discussion). Deemed to have nearly completed its extratropical transition, the final warning was issued valid at 200600Z.

### III. DISCUSSION

#### a. *Tom's behavior in a reverse-oriented monsoon trough*

When the monsoon trough acquires a reverse orientation, a ridge of high pressure often builds to its south creating steering flow which causes TCs associated with the reverse-oriented monsoon trough (RMT) to move on north-oriented tracks. Premature eastward motion at low latitude is a common behavior of TCs located along the axis of an RMT. Such eastward turns at low-latitude are not considered "classic recurvature" because the TC is being steered by dominating monsoonal flow rather than by entry into the midlatitude westerlies. Often, the subtropical ridge is still in-place to the north of the RMT, and the TC is seen to undergo "S" motion (i.e., making a turn back to the northwest while moving through the subtropical ridge and entering the midlatitude westerlies). Another characteristic behavior of TCs while embedded in an RMT is intensification of the TC while moving on a track with an eastward component of motion (such was the case with Tom). The monsoon trough within which Tom was embedded, became reverse oriented by virtue of the relative motion of Tom and Violet (26W) (Figure 3-25-3). Both of these TCs moved on similarly shaped tracks, however, there was a gradual cyclonic rotation of the two about their centroid so that Tom, once east-southeast of Violet, moved to the east-northeast of Violet. For further information regarding the behavior of TCs associated with an RMT see Lander (1996) and the discussion of reverse-trough formation and poleward-oriented motion in Carr and Elsberry (1994).

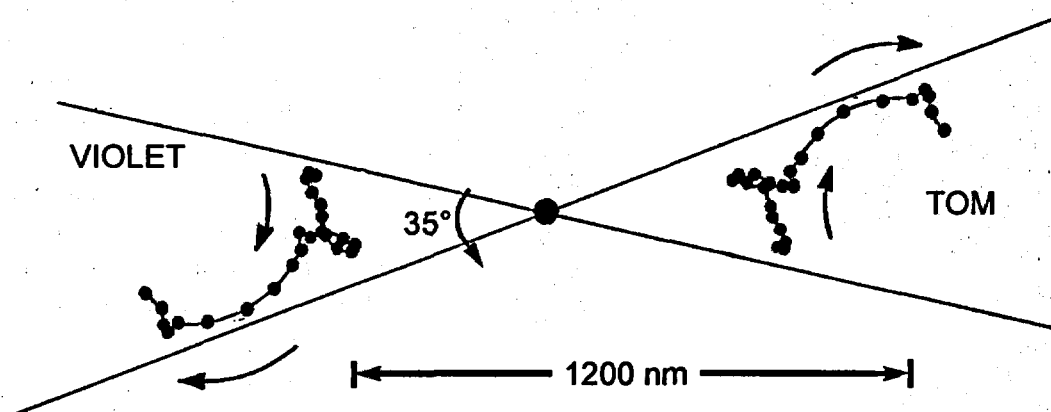


Figure 3-25-3 Centroid relative motion of Tom and Violet (26W). Dots are at 12-hour intervals beginning at 100000Z and ending at 220000Z.

#### b. *Unusual cloud signature*

When Tom reached its peak intensity of 75 kt (39 m/sec), it had an unusual structure featuring a "pin-hole" eye in a small central cloud mass surrounded by extensive peripheral rain bands within a large outer wind field (Figure 3-25-2). Tom is a good case for the argument that the core of a TC is largely independent of its outer structure. Take away the peripheral rain bands and the deep convection extending southwestward within the monsoon flow and Tom's small core is indistinguishable from a small TC with a small eye. By contrast, Typhoon Violet (26W) (located to the west of Tom) had a size similar to Tom, and yet the structure of its core was quite different: Violet's eye began small, but then expanded to a diameter on the order of 75 nm (140 km). The distinction between the TC core and its outer structure also has relevance to the evolution of monsoon depressions to conventional TCs (i.e., one of Dvorak's four data types). It is not clear by what pathway monsoon depressions become conventional TCs.

*c. On the use of scatterometry to assess the wind distribution of large TCs*

One of the limitations of the ERS-2 scatterometer data is its narrow swath width (approximately 7 degrees of great circle arc). When available, JTWC uses scatterometer data to evaluate the outer wind distribution of TCs (i.e., the radial extent of gales). For small TCs, the scatterometer often misses the TC for several passes, and even misses the peripheral gale area. For larger TCs like Tom, almost every scatterometer pass in the region of the TC samples a portion of its gale area, and thus, by piecing together the several hits on portions of the gale area, a picture of the wind distribution emerges—the problem of narrow swath width has less impact.

*d. First use of the "XT" technique*

A review of the 1994 and 1995 WNP TC data revealed the intensity estimates of a significant number of TCs that recurved and moved out of the tropics were underestimated by the TC satellite reconnaissance network which used Dvorak's techniques to determine intensity. Intensity estimates for Dan (06W) as it was recurving illustrate the problem (see Dan's (06W) summary). In order to address the problem of underestimating the intensity of TCs undergoing extratropical transition, satellite forecasters at the JTWC in conjunction with ONR-supported researchers at the University of Guam devised a technique (Miller and Lander, 1996) for estimating the intensity of TCs undergoing extratropical transition (see Dan's summary for more details on the technique). This technique yields XT (for extratropical transition) numbers that equate to wind speeds identical to Dvorak's T numbers of the same magnitude. The first application of the technique was on Tom as it was becoming extratropical. The JTWC satellite fix at 192330Z represented the first assignment ever of an XT number to a TC. The XT number determined for Tom at this time was XT 3.0. Other agencies using Dvorak's T numbers, or Hebert and Poteat's ST numbers were up to two T numbers lower than the JTWC intensity estimate. Scatterometer data and other synoptic data at the time supported the JTWC intensity estimate of XT 3.0 (i.e., 45 kt (23 m/sec)).

#### IV. IMPACT

No reports of damage or injury were received at the JTWC.